

## Comet Simulation Experiments at JPL

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A new laboratory for the physical simulation of cometary nuclei and cometary surface processes has been developed at the Jet Propulsion Laboratory. In this paper we will present our experimental setup and first results of the laboratory simulation of cometary nuclei. This work is in direct support of upcoming NASA missions to cometary nuclei. Over the past two years we have developed a variety of laboratory hardware and methodologies to: create cryogenic ice-dust mixtures, contain and process the materials in a specially designed cryogenic high vacuum chamber, and study the effects of insolation from measurements of the changing physical properties of the cometary mixtures. In particular, we create suspensions of water and minerals with a composition similar to those expected of cometary nuclei, based on telescopic and spacecraft observations. We can finely specify the particle size range of the minerals through the use of an air jet sieve system that allows us to grade particles to sizes less than 5 microns. After a mixing procedure that includes the ultrasonic break-up of flocculated particles, the suspension is atomized and sprayed into a liquid nitrogen bath contained in a LN<sub>2</sub>-cooled, instrumented sample canister (cylinder: diameter = 0.20 m; depth = 0.25 m), which is adaptable enough to provide cooling for the back-plate only, sides only, or for the entire canister. Upon completion of the formation of the cometary analog materials, we transfer the sample canister to the cryogenic vacuum chamber ( $10^{-4}$  Pa). Once in the vacuum chamber, the canister can be oriented from 0-45 degrees with respect to the incoming insolation. The solar simulator output covers 0.1-2.1 Solar Constant. Temperatures are measured with 10 sensors in the ice-dust mixture inside the canister. The gas release is monitored as a function of time with two mass spectrometers: one for the lower pressures and one for the higher pressures that may develop during an outburst. Dust release is recorded on video tape. A mechanical penetrator-scratcher measures penetrability and disturbs the surface for assessment of surface changes. At the end of the experiment, the sample is removed and core samples are taken for tests of compression strength, penetrability, porosity, density, and thin section analysis. Methods allowing detailed microscopic examination of the samples are under development. A freezing microtome for cutting thin sections of the sample and a freezing stage on a microscope are to be used for examination of the pore and grain structure of the icy mixtures. With all elements in place for the laboratory simulation of cometary materials, we are now performing our first experiments and plan to report our preliminary results.